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TELECOMMUNICATION STATION CABLES WITH SCREENED PAIRS
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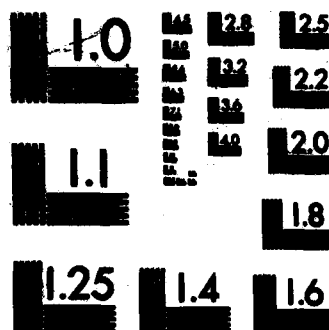


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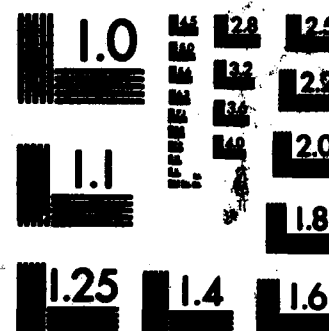
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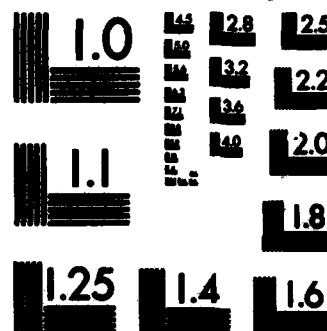
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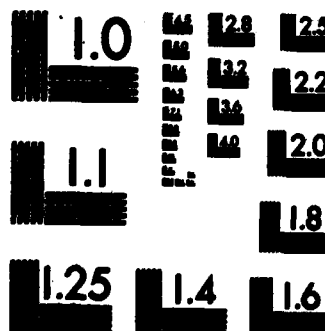
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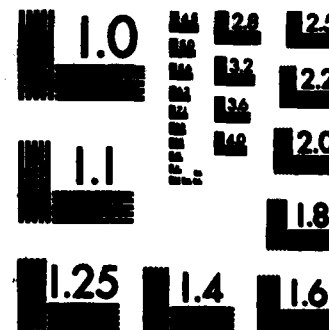
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by

Tadeusz Lapinski



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TELECOMMUNICATION STATION CABLES WITH SCREENED PAIRS

Tadeusz Lapinski, engineer, M.S.

Telecommunication station cables with insulation and polyvinyl coating with screened pairs are intended for telecommunication station to station connections in multiple-system equipment for frequencies greater than acoustic frequencies.

These cables make possible the correct operation of equipment in rooms at temperatures varying from -10 to +50°C in cases where mechanical hazards occur in the form of bending or vibrations and from -40 to +70°C in cases where mechanical hazards do not occur. These cables can be laid at a temperature varying from 0 to 40°C.

The cable factory in Ozarow Mazowiecki is manufacturing cables with screened pairs designated by the symbol YTKSYekp in accordance with WT-79/K-121 technical specifications with the number of pairs: 2-6-7-10-12 and 21. Cables with a different number of pairs can be produced by mutual agreement of the parties.

The cable strands are made from soft copper wire (either nonzinc-coated or zinc-coated) with a 0.5 mm nominal diameter. These strands ensure that solid and covered joints can be made. The latter must be zinc-coated and have a rupture elongation in the range of 15-30%.

The strands are insulated with plasticized polyvinyl chloride (insulation thickness 0.15-20 mm).

The insulated strands are stranded into pairs using a length of lay which does not exceed 80 mm. The length of lay of individual pairs is selected in a way which ensures the smallest possible energy transfer to other transmission lines.

Each pair is screened individually. The electrostatic screen of the pair is made in the form of a wrapping or a longitudinal arrangement, with an overlap, from an aluminum foil (minimum thickness 0.04 mm) or from a synthetic tape covered on both sides by a copper or aluminum layer. The overlap constitutes at least 20% of the width of the tape.

The screened pairs are stranded layer to the layer to the core of the cable, using a length of lay which does not exceed 600 mm. The number of pairs in the core and in individual layers is presented in Table 1.

Table 1. Number of pairs in core and in layers

Pairs per cable (a)	Pairs per (b)		
	in core (c)	in 1st layer (d)	in 2nd layer (e)
2	2	-	-
4	4	-	-
6	6	-	-
8	8	-	-
10	10	-	-
12	12	-	-
14	14	-	-
16	16	-	-
18	18	-	-
20	20	-	-
22	22	-	-
24	24	-	-
26	26	-	-
28	28	-	-
30	30	-	-
32	32	-	-
34	34	-	-
36	36	-	-
38	38	-	-
40	40	-	-
42	42	-	-
44	44	-	-
46	46	-	-
48	48	-	-
50	50	-	-
52	52	-	-
54	54	-	-
56	56	-	-
58	58	-	-
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62	62	-	-
64	64	-	-
66	66	-	-
68	68	-	-
70	70	-	-
72	72	-	-
74	74	-	-
76	76	-	-
78	78	-	-
80	80	-	-
82	82	-	-
84	84	-	-
86	86	-	-
88	88	-	-
90	90	-	-
92	92	-	-
94	94	-	-
96	96	-	-
98	98	-	-
100	100	-	-

Key: (a) Number of pairs in cable
 (b) Number of pairs
 (c) In core
 (d) In first layer
 (e) In second layer

All pairs in cable cores are distinguished unambiguously. The code recommended by the International Electrical Engineering Commission (CEI) was adopted to distinguish pairs in cable core. Individual strands have insulation with a uniform color or two-color insulation. Two-color insulation is made by printing colorings on the basic colors obtained by coloring the insulation in the compound. A selection of any of the two mentioned

colors as the basic color is permissible. The color of the insulation and compound as a rule is lighter in comparison with the color of the rings.

The method used for printing colorings on the insulation of strands is illustrated in Fig. 1. The width of the coloring is 2.5 ± 0.5 mm, whereas the distance between the end of the preceding link and the beginning of the next link is 7.5 ± 1.0 mm.

Table 2 presents the color designation of the insulation of strands in pairs and the sequence in which they are laid in the core of the cable.



Fig. 1. Overprint of colored rings on strand insulation

Individual layers in cable cores (except a core made from one pair and the external layer) can be covered with a yarn or a tape from a non-hygroscopic material, for example, made from polyester or polyolefins. The color of the covers is red (for the core) and blue (for the first layer).

A common screen made in the form of a wrapping of an aluminum foil (thickness 0.05 mm) with an overlap of at least 20% is wrapped around the cable core. The ground strand made from a soft thin-coated copper wire (0.5 mm nominal diameter) is laid on the screen on the cable core parallel to its axis. A wrapping from a thin tape made from a nonhygroscopic material can be wrapped around the screen of the core.

A plasticized polyvinyl chloride coating forced in on the cable core is produced in this manner. The color of the coating is gray or black and its nominal thickness is given in Table 3. Negative deviations from the thickness of the polyvinyl coating must not exceed 0.1 mm to 15% of the nominal thickness. The largest outer diameters of the station cables are presented in Table 3.

Table 2. Color designation of strand insulation in cable pairs in cable cores

Numer kolejnej wiązki parowej (a)	Barwa izolacji żył w wiązkach parowych (b)	
	żyła a (c)	żyła b (d)
1	2	3
1	biała (e)	(i) niebieska
2		(j) pomarańczowa
3		(k) zielona
4		(l) brązowa (1)
5		(m) szara
6	czerwona (f)	(i) niebieska
7		(j) pomarańczowa
8		(k) zielona
9		(l) brązowa (1)
10		(m) szara
11	czerwona (f)	(i) niebieska
12		(j) pomarańczowa
13		(k) zielona
14		(l) brązowa (1)
15		(m) szara
16	żółta (g)	(i) niebieska
17		(j) pomarańczowa
18		(k) zielona
19		(l) brązowa (1)
20		(m) szara
21	niebiesko-biała (h)	(i) niebieska
22		(j) pomarańczowa
23		(k) zielona
24		(l) brązowa (1)
25		(m) szara

Key: (a) Sequential number of pair
 (b) Color of strand insulation in pair
 (c) strand A
 (d) strand B
 (e) white
 (f) red
 (g) yellow
 (h) white-blue
 (i) blue
 (j) orange
 (k) green
 (l) brown
 (m) gray

Table 3. Thickness of coating and outer diameters of cables

Liczba par (a)	Grubość powłoki (b) mm	Największa dopuszczalna średnica zewnętrzna (c) mm
2	0,5	6,5
4	0,5	8,0
7	0,5	8,0
10	0,5	9,5
12	0,5	10,0
21	1,0	12,5

Key: (a) Number of pairs
 (b) Nominal thickness of coating, mm
 (c) Largest admissible outer diameter of cable, mm

Each cable has the manufacturer's trademark, comprising a letter symbol for the cable, the name of the factory, and the manufacturing year embossed on the coating. The distances between the end and the beginning of neighboring symbols does not exceed 50 cm.

The length of factory cable segments is 500 ± 5 m or a multiple of this value.

The ends of the cables are terminated in a tight manner, using caps contracting under heat or in some other manner ensuring tightness of the cable.

Loop resistance of strands of pairs in 1 km finished cable does not exceed 195.6Ω at 20°C temperature.

Strand insulation withstands without breakdown for 1 min an alternating test voltage (frequency 50 Hz, rms value 100 V) or a constant voltage (1500 V) applied between all "a" strands connected to each other and all "b" strands connected to each other, to the screen, and to the ground.

The resistance of the insulation of each strand in 1 km finished cable, with respect to the remaining strands connected to each other, measured by a constant voltage at temperatures $20 \pm 5^{\circ}\text{C}$ is at least $500\text{ M}\Omega$.

The capacitance of each pair in 1 km finished cable does not exceed 120 nF.

The crosstalk attenuation between screened pairs in the frequency band up to 2 MHz is greater than 100 dB (it is actually at the 105 dB level).

The tensile strength of the insulation and polyvinyl coating before and after thermal aging in the surrounding air atmosphere is at least 12.5 MPa, and the rupture elongation under the same conditions constitutes at least 125%. Changes in tensile strength and elongation strength during rupture after aging compared to strength and elongation before aging do not exceed 20%.

The insulation and coating are flexible for winding at a -10°C temperature and at a $+150^{\circ}\text{C}$ temperature. The resistance to pressure at a higher temperature is such that the coating after being subjected to a load at an 80°C temperature retains at least 40% of its original thickness in the deformation area. Contraction of the insulation does not exceed 5%. In addition, both the insulation and coating are resistant to a propagating flame. The insulation and the coating, after exposure to a flame for 60 s, do not burn longer than 30 s (in the event they catch fire).

Structural designs of telecommunication cables with individually screened pairs, their manufacturing technology and engineering properties are on a par with the latest worldwide achievements in cable engineering.